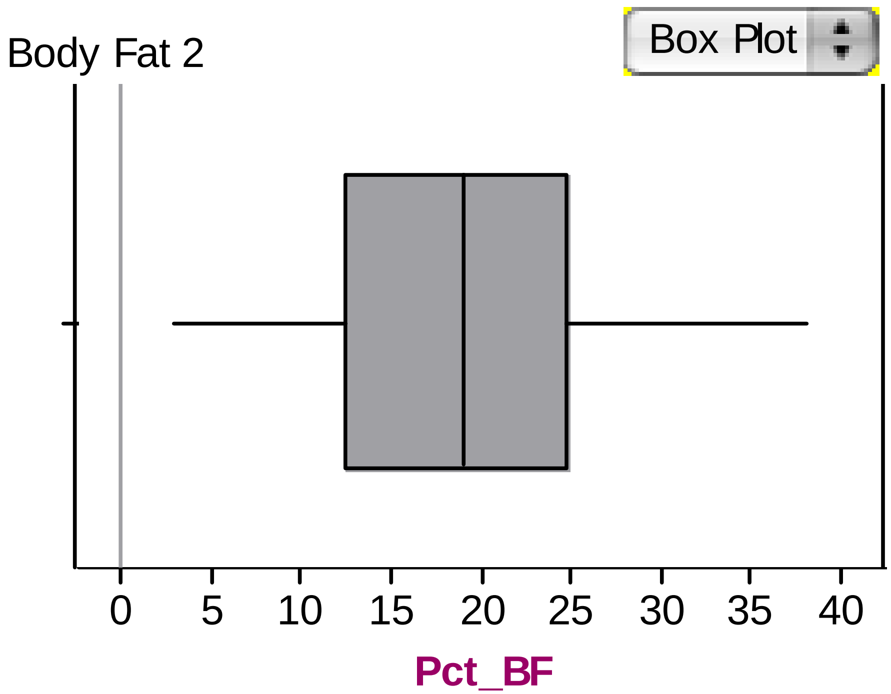
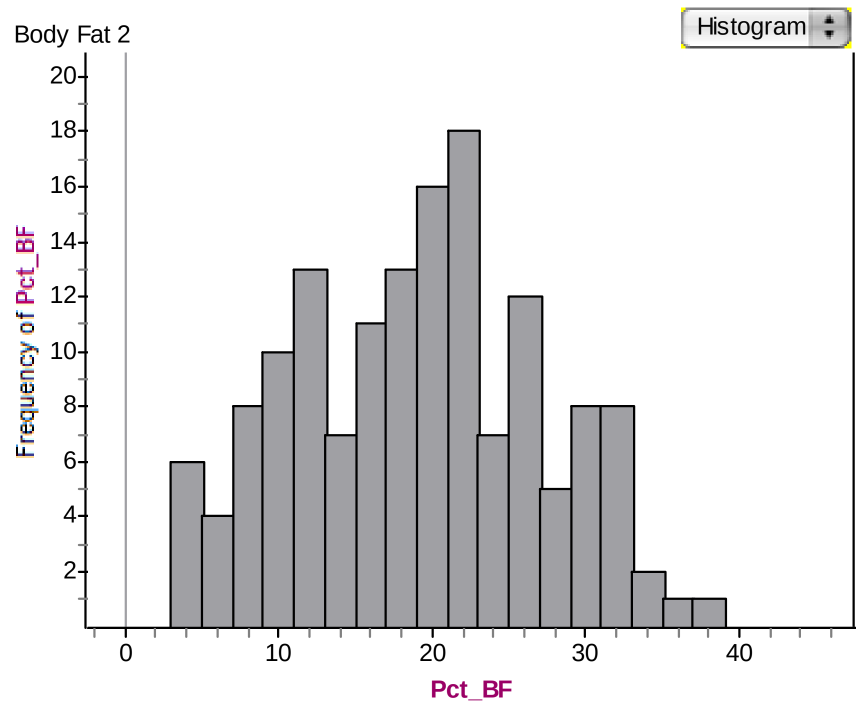
ADULT MALE % BODY FAT

Background

- This data was taken to see if there are any variables that impact the % Body Fat in males
  - Height (inches)
  - Waist Size (inches)
  - Chest Size (inches)
  - Percent Body Fat (%bf)
- Each variable was then compared to the calculated % Body Fat to see if there was a correlation between the two

% Body Fat


Body Fat 2
Box Plot
0
5
10
15
20
25
30
35
40
Pct_BF


Body Fat 2
Histogram
Frequency of Pct_BF
20
18
16
14
12
10
8
6
4
2
0
10
20
30
40
Pct_BF

Summary Statistics (% Body Fat)

- Min: 3%
- Q1: 12.4%
- Med: 19.15%
- Q3: 24.8%
- Max: 38.1%
- Mean: 18.974%
- Std. Dev.: 7.921%

Outlier Test

24.8-12.4 = 12.4

12.4(1.5) = 18.6

UF: 24.8+18.6 = 43.4%

LF: 12.4-18.6 = -6.2%

There are no outliers present

Graph Description

- The data are unimodal and roughly symmetric
- The graph's center is its mean of 18.974% Body Fat
- The spread of the data is represented by the std. deviation of 7.921% and a (3%, 38.1%) range
- There are no outliers

Percent of Males Overweight

- $P(x>19\%) = 78/150 = .52$ or 52% Overweight
- $P(x\leq 19.1\%) = 72/150 = .48$ or 48th percentile (first overweight male)
- $P(x>25\%) = 37/150 = .247$ or 24.7% Obese
- $P(x\leq 25.2\%) = 113/150 = .753$ or 75th percentile (first obese male)

Z-Score of first obese male $\dfrac{25.2-18.974}{7.921} = .786$

Compared to Normal Model

- Between one standard deviation in either direction from 18.974% Body Fat (mean) is 64% of the data
  - $P(11.053<x<26.895) = 96/150 = .64$ or 64%
  - This is lower than the expected 68% for normal data
- Between two standard deviations in either direction from the mean is 98%
  - $P(3.132<x<34.816) = 147/150 = .98$ or 98%
  - This is higher than the expected 95% for normal data
- There is no data that reaches three standard deviations from the mean
  - The final 2% falls between two and three standard deviations

Shortest Men

- Three Shortest Men at 64in. Tall
  - Man #1 – 13.5% Body Fat
  - Man #2 – 13.5% Body Fat
  - Man #3 – 13.5% Body Fat
- All three men have % body fat that Is higher than the minimum 3%
  - Shows that height is independent of % body fat

Z Scores

Z-Score of shortest men's height

$$\frac{64-70.515}{2.663} = -2.446$$

Z-Score of shortest men's % Body Fat

$$\frac{13.5-18.974}{7.921} = -.691$$

The shortest men have the smallest Z Score for height. The score would normally be around a 3, but because the standard deviation is 2.663, the data does not go to 3 standard deviations from the mean.

The Z Score for % Body Fat is not the lowest as predicted. It is below 1 z score from the mean, or within 64% of the data. This proves that height is independent of % Body Fat as the shortest men had the lowest Z score for height, but not for % Body Fat

Tallest Men

- Two tallest men at 77.5in tall
  - Man #1 – 10.3% Body Fat
  - Man #2 – 10.3% Body Fat
- Both men have % body fats that are lower than the maximum of 38.1% body fat
  - Re-confirms that height is independent of % body fat

Z Scores

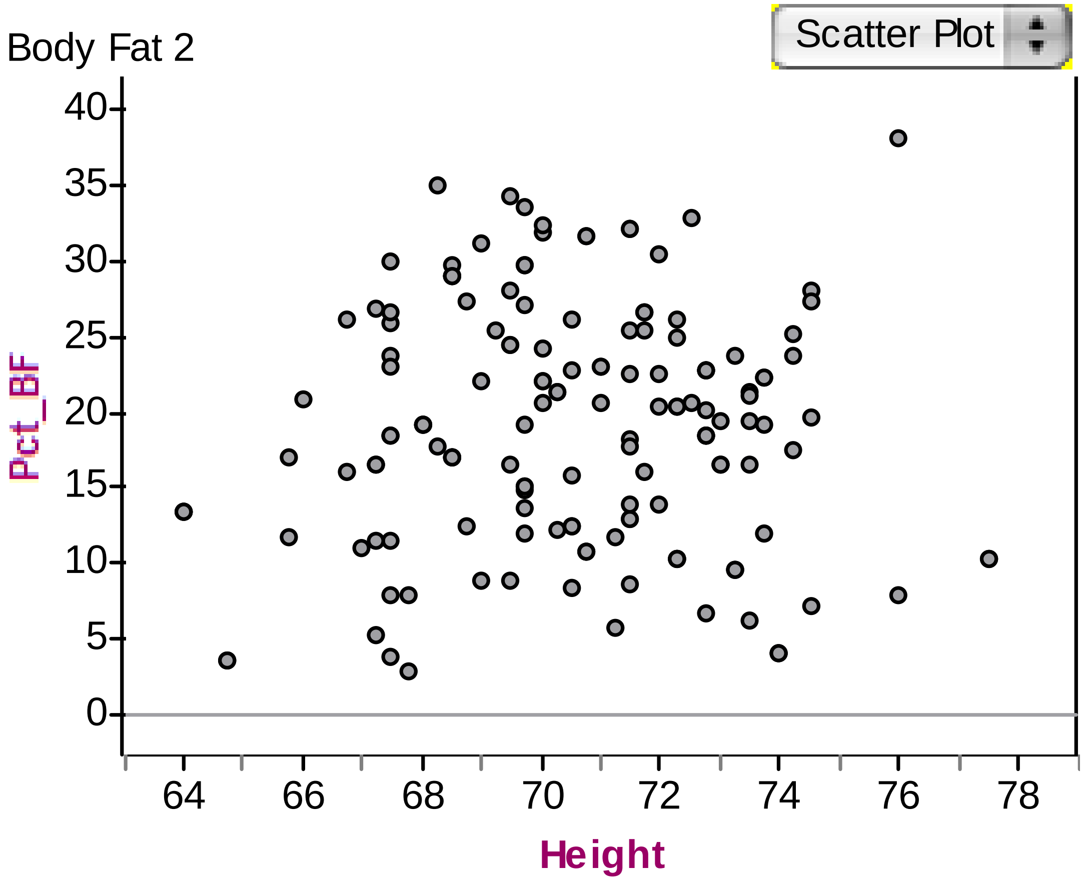
Z-Score of tallest men's height $$\frac{77.5-70.515}{2.663} = 2.623$$

Z-Score of tallest men's % body fat $$\frac{10.3-18.974}{7.921} = -1.095$$

The tallest men have the largest Z Score for height. As with the shortest men, the score would normally be around 3, but the data does not reach as far as 3 standard deviations

The Z Score for % Body Fat is not the highest as predicted. It is just above 1 standard deviation away from the mean. This proves that the tallest men will not have the highest % Body Fat, as the score for height is the largest, but the score for % Body Fat is not.

Height: Scatterplot



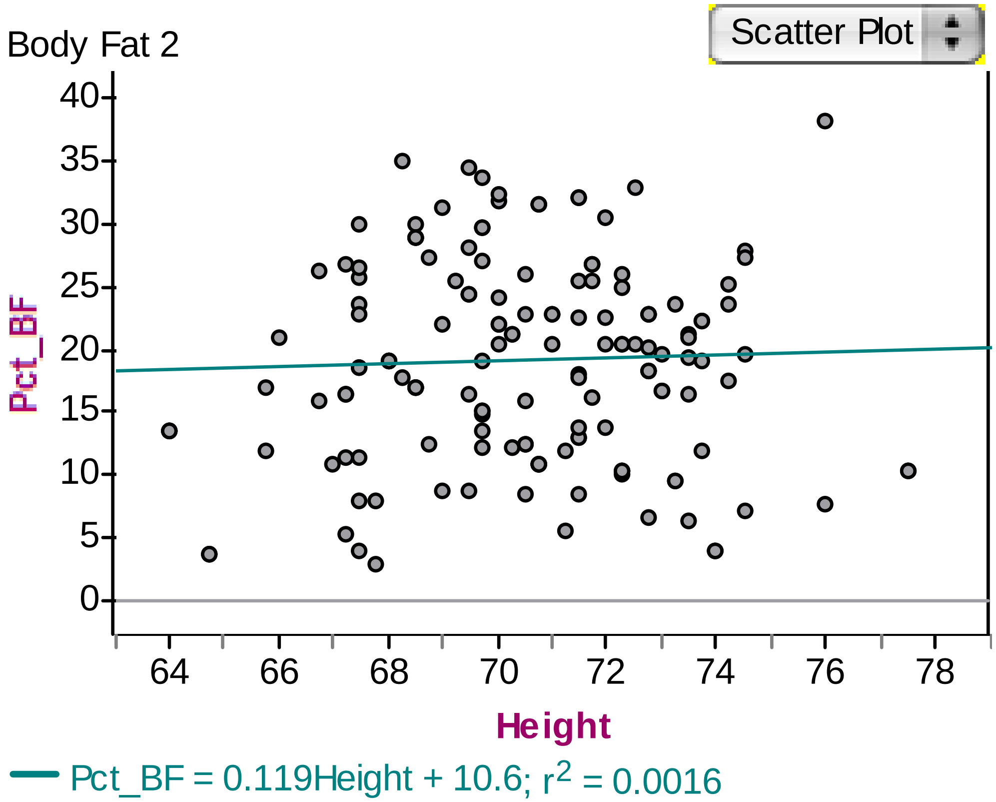
Description

- Form: Scattered
- Direction: No Association
- Strength: Scattered
- There is essentially no correlation between the two variables so there are no unusual points (outliers, high leverage, influential)

LSRL Equation

- $\widehat{\text{Pct\_BF}} = 10.590 + 0.119(\text{Height})$

Scatterplot w/ LSRL



- r= 0.040

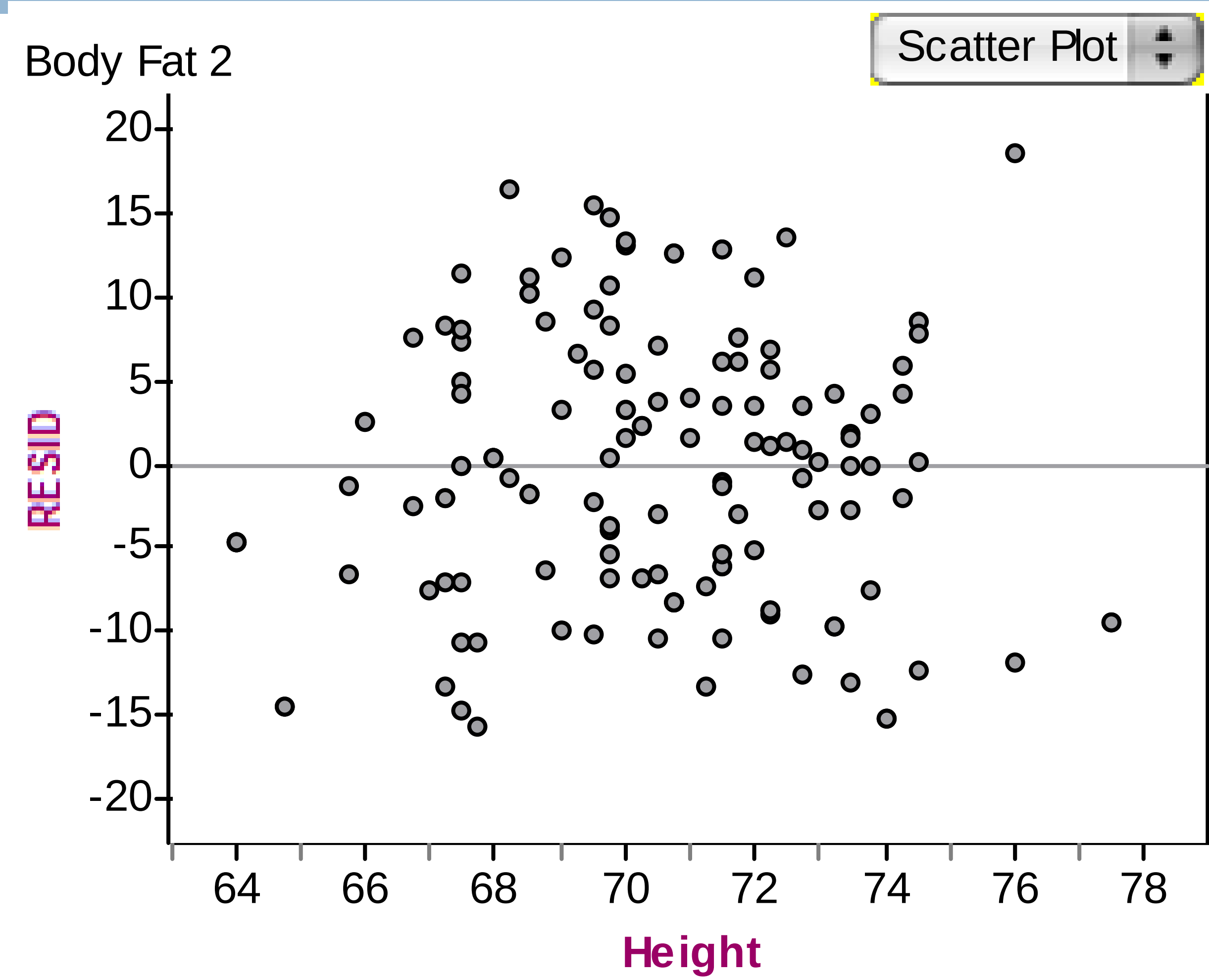
Interpreting Slope

- For every additional inch in height, there is a increase in 0.119% body fat from a base body fat of 10.590% on average

Interpreting r^2

- $r^2 = 0.0016$
- 0.16% of the change in percent body fat is a result of the change in height

Residual Plot



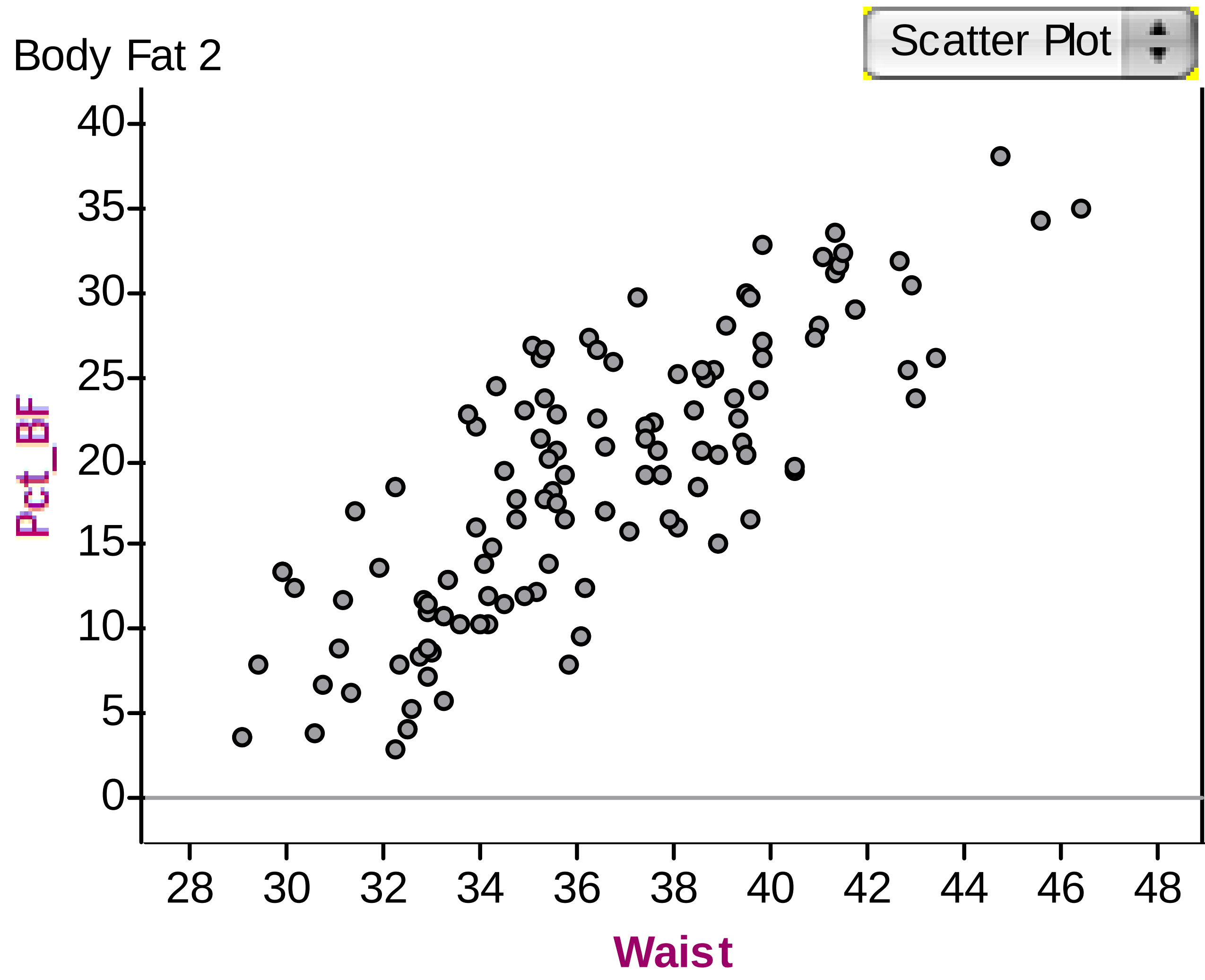
Description

- The residual points are scattered and have no set pattern between the positive and negative residuals

Is the model a good fit?

- I do not think that a linear model is a good fit for the data
- The original plot is scattered with no indication of where a linear model could possibly represent the entirety of the data
- However, the residual plot has scattered points and would appear to show a linear model being fine
- Nevertheless, the correlation of 0.040 further proves that the data has almost no correlation and that a linear model is not a good fit

Waist size: Scatterplot



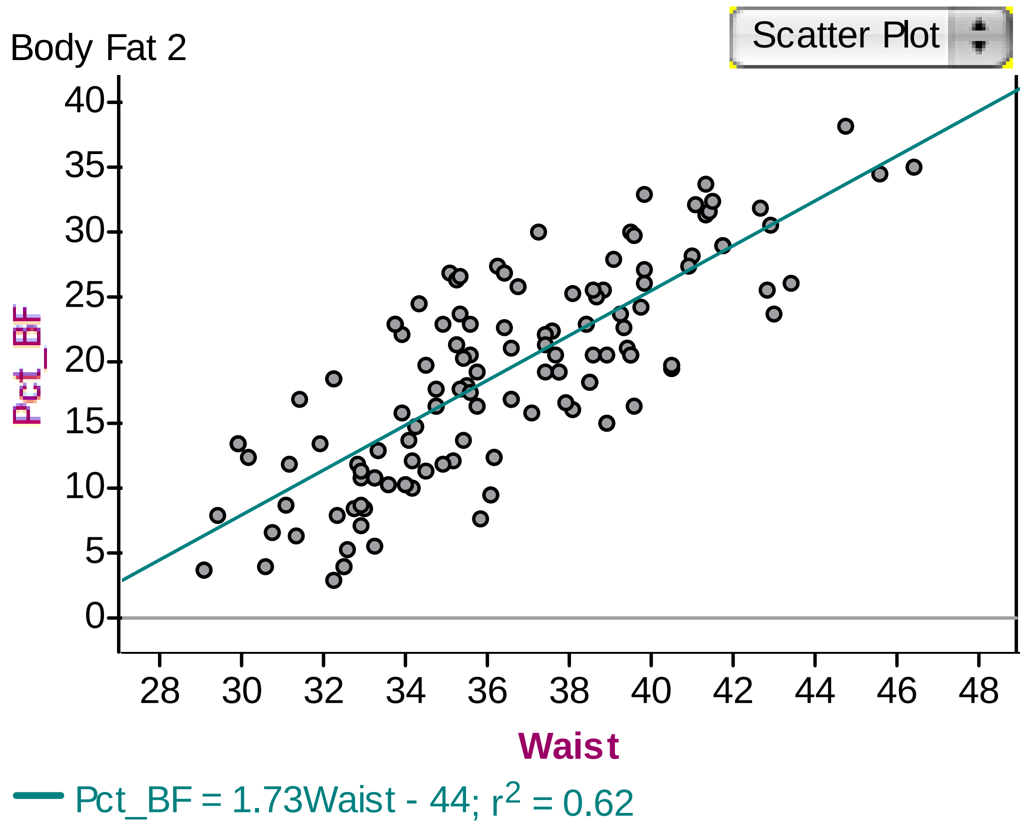
Description

- Form: Linear
- Direction: Positive
- Strength: Moderately Strong
- No unusual points

LSRL Equation

- $\widehat{\text{Pct\_BF}} = -44.112 + 1.734(\text{Waist})$

Scatterplot w/ LSRL



- r= 0.789

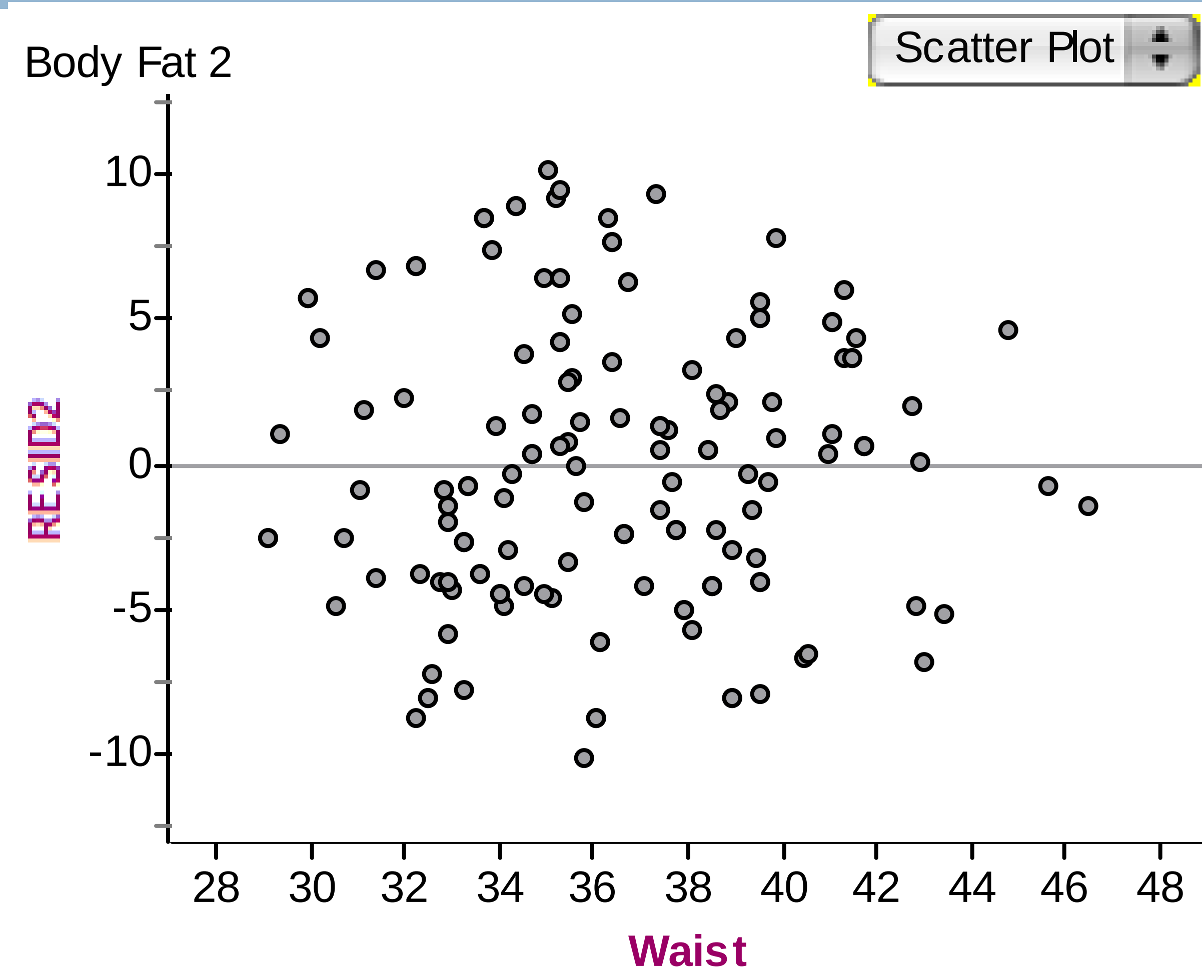
Interpreting Slope

- For every additional inch in waist size, there is 1.734% of body fat added on from a base percent of -44.112% on average

Interpreting r^2

- $r^2 = 0.623$
- 62.3% of the change in percent body fat is affected by the change in waist size

Residual Plot



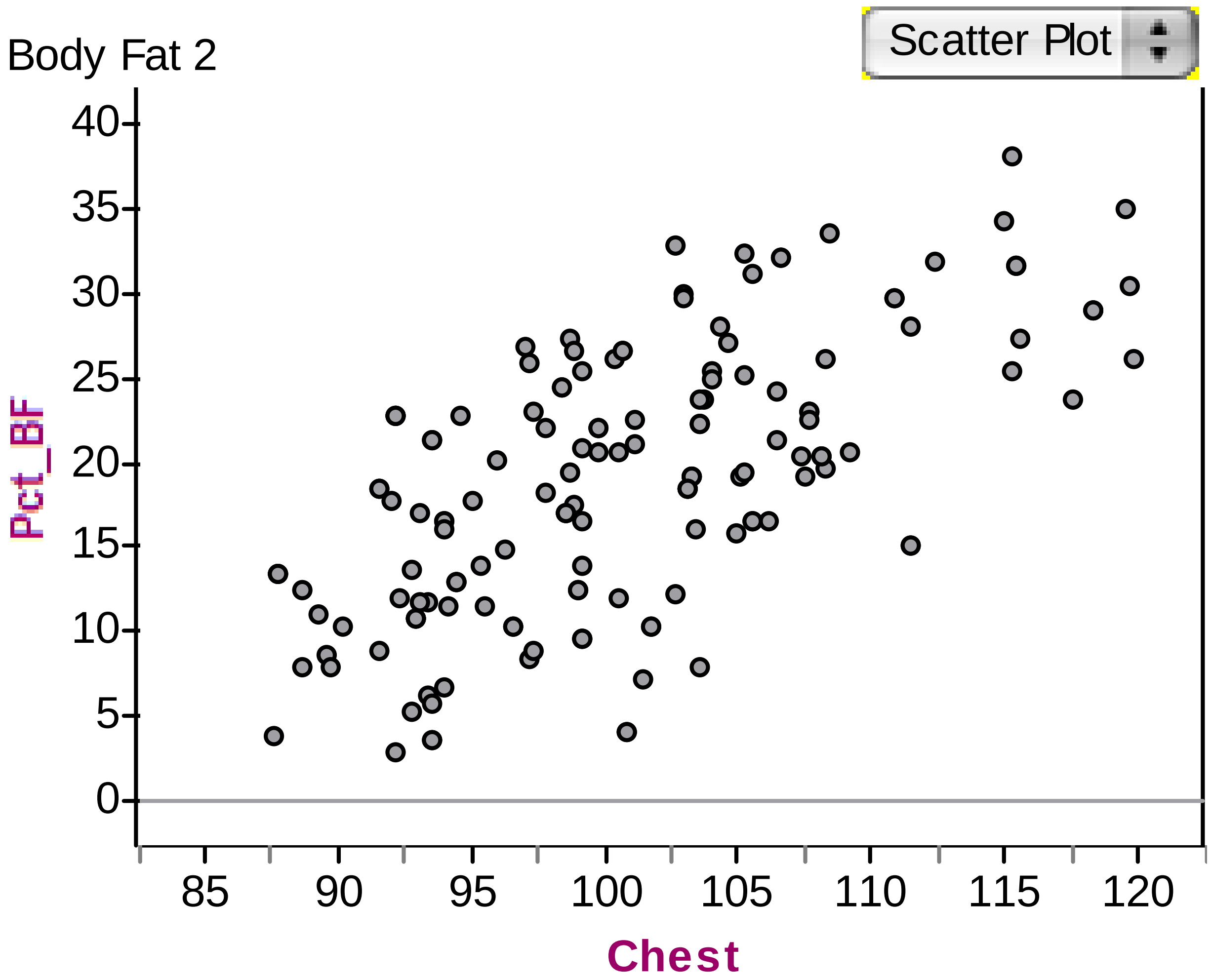
Description

- The residuals are scattered throughout and there is no pattern shown between the positive and negative residuals

Is the Model a Good Fit?

- Yes the linear model is a good fit for the data
- The original scatterplot had its points close to one another and in a distinct linear form making the model pass through or be close to all the points
- The residual plot had scattered points and no set pattern
- The correlation of 0.789 further proves the linear model is a good fit by showing that the scatterplot is strong

Chest size: Scatterplot



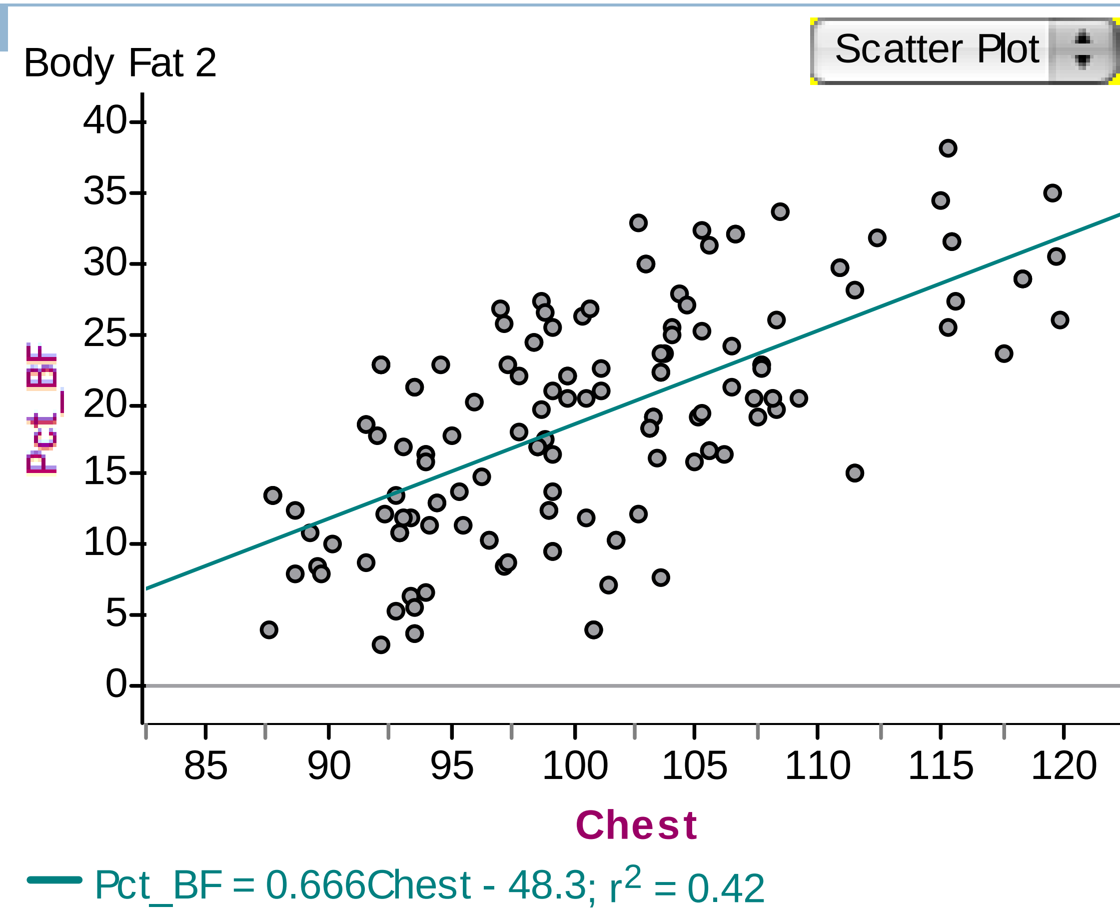
Description

- Form: Linear
- Direction: Positive
- Strength: Moderate
- No unusual points

LSRL Equation

- $\widehat{Pct\_BF} = -48.285 + 0.666(Chest)$

Scatterplot w/ LSRL



- r= 0.651

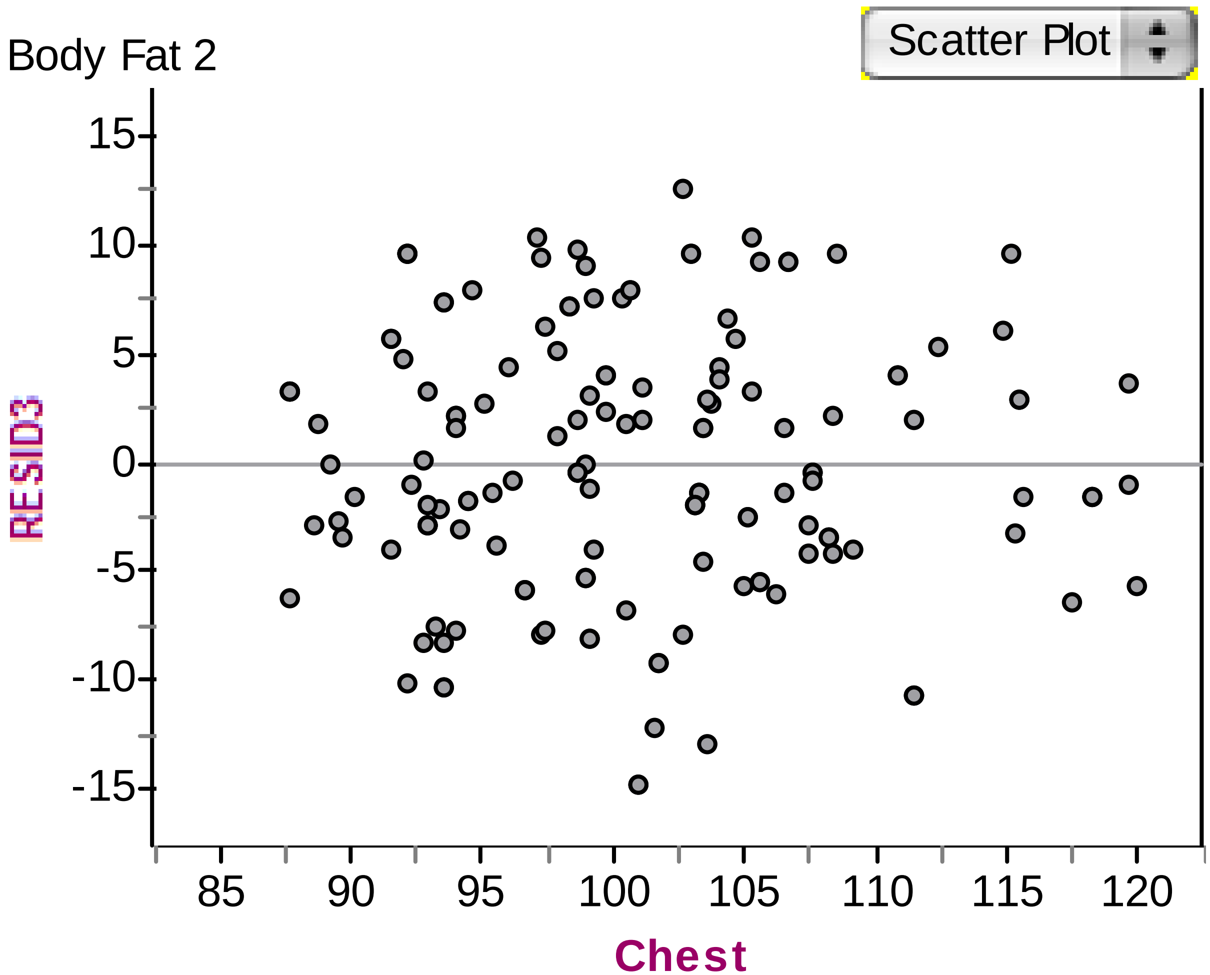
Interpreting Slope

- For every additional inch in chest size, there is an increase of 0.666% in percent body fat from a base percent of -48.285% on average

Interpreting r^2

- $r^2 = 0.424$
- 42.4% of the change in percent body fat is affected by the change in chest size

Residual Plot



Description

- The residuals are scattered and there is no pattern shown between the positive and negative residuals

Is the Model a Good Fit?

- Yes the linear model is a good fit for the data
- The original scatterplot has points that are relatively close to one another and shows a distinct linear form, so that a linear model go through or be close to a majority of the points
- The residual plot has scattered points and there is no pattern shown for the residuals
- The correlation of 0.651 further reinforces that fact that a linear model is a good fit because it shows that the scatterplot is strong

The Best Model

- Waist size is the best model to use for predicting percent body fat
- Height is definitely not because there is essentially no correlation between it and percent body fat
- Chest size does have good correlation with percent body fat, but waist size has a stronger correlation and therefore a more linear model with percent body fat

Percent Body Fat Predictions

- Low: $\widehat{\text{Pct\_BF}}$= -44.112 + 1.734(30.16)= 8.185%

- Middle: $\widehat{\text{Pct\_BF}}$= -44.112 + 1.734(36.26)= 18.763%

- High: $\widehat{\text{Pct\_BF}}$= -44.112 + 1.734(42.72)= 29.964%

Residuals

- Low: 12.5% - 8.185%= 4.315%
- Middle: 27.2% - 18.763%= 8.437%
- High: 31.9% - 29.964%= 1.936%

Possible Lurking Variables

- Time (hours) spent exercising per week
- Grams of saturated fat eaten per day

Conclusion

- There is no discernable correlation between %BF and height
  - Scatterplot did not have a pattern
- There is a clear association between %BF and waist size
  - It appears to be that as waist size increases, %BF usually increases as well
    - According to the graph, 62% of the change in %BF is due to the change in waist size
- There is probably an association between %BF and chest size
  - As chest size increases, %BF usually increases
    - According to the graph, 42% of the change in %BF is due to the change in chest size

Conclusion (cont.)

- This data is not conclusive of what exactly causes %BF in Adult Males
  - Factors such as exercise and diet were not considered, and possibly could have an impact on %BF
  - The sample size was also limited to 150 individuals, so this group could be limited to sampling error